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CHICAGO ACADEMY OF SCIENCES.

REPORT OF THE COMMITTEE ON THE
MICROSCOPIC ORGANISMS IN THE BOWLDER
CLAYS OF CHICAGO AND VICINITY.

H. A. JOHNSON, M. D.,
B. W. THOMAS, F. R. M. S., } *Committee.*

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H. A. JOHNSON, M. D., B. W. THOMAS, F. R. M. S., Committee.

At the regular monthly meeting of the Chicago Academy of Sciences, held Tuesday evening, January 15, 1884, the following paper was submitted by the special committee to which had been assigned the task of investigating the "boulder clays" underlying this city:

While the lake tunnel, for the purpose of supplying the city of Chicago with water from Lake Michigan, was in process of construction, specimens of the clay through which the excavation was made were subjected to microscopical examination by several members of the Academy; for the purpose of determining the presence or absence of organic remains. This was during the years 1865 to 1867. The result of these examinations was the discovery by the members of the present committee and others of a disc, varying from $\frac{1}{85}$ part of an inch to $\frac{1}{250}$ of an inch in diameter. They were yellow in color, apparently flat or concavo-concave, and were unknown to any paleontologist to whom they were submitted. On the completion of the lake tunnel, large numbers of the same discs were frequently observed in the precipitate from the city water supply. Slides were sent to New York and to London, but without obtaining any information on the matter. The subject was then allowed to rest, and nothing further was done toward ascertaining their character, distribution, or affinities till the last summer, when an examination of clays collected by an exploring party of the Academy from the high bluffs on the shore of Lake Michigan, twenty miles north of this city, revealed the presence of discs identical in character with those found in the tunnel clays and in the precipitate from the lake water. As a result of this discovery, the present committee was formed and instructed to more thoroughly investigate the microscopic organisms of our boulder clay.

In the performance of this duty, the committee have examined many specimens of clay and their contents of fragments of shale, etc., from this vicinity, and also of clay and shale from the Carboniferous deposits of Illinois and other States. Slides from these clays and shales, as well as from our own deposits, and from our city water supply, have been prepared and are under the microscopes for examination at the close of the paper.

The committee have some additional information in regard to these discs, but before entering upon the results of their own study, they beg to call the attention of the Academy to the literature of the subject, for, since 1867, there has been created a literature.

In 1871, Prof. J. W. Dawson, of Montreal, described a form found in the shales at Kettle Point, Lake Huron, known as the Erian formation, and which has been referred to the Marcellus shales of New York. The descriptions of Prof. Dawson apply fairly well to the bodies found here and first noticed in 1865-66-67. They are evidently the same or belong to the same family. Since Dr. Dawson's article these bodies have been found in widely distant localities, but always in shales of the upper Devonian age, or in close relation to them, the only exception being, so far as known to the committee, the clays of Chicago and vicinity. With the same exception they have always been found *in situ*—that is, in deposits which have not been transported or disturbed. These microscopic forms, found in abundance in our boulder clay and in the city water supply, testify to the former existence of the oil-bearing shales in areas from which denudation has now entirely removed them.

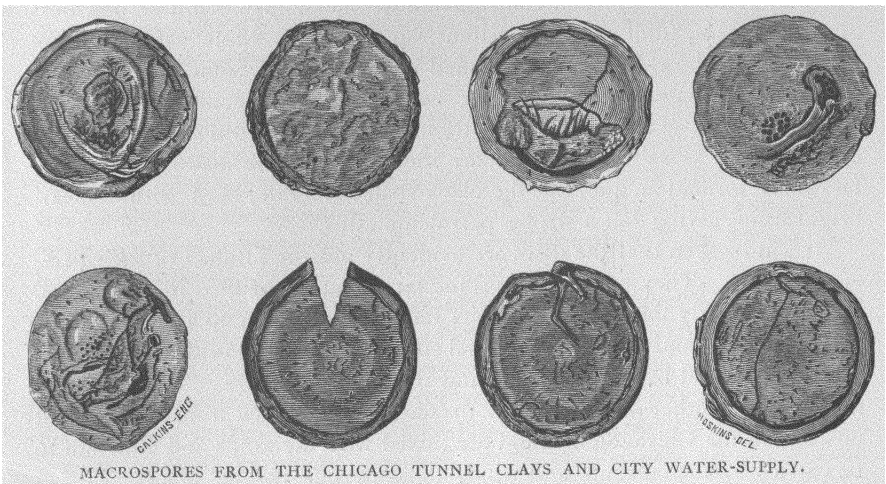
Prof. Dawson described these discs as brownish in color, in his paper published in 1871. He considered them as spore cases or *Macrospores* of some *Acrogenous* plant. This paper was published in the *American Journal of Science* for April, 1871. They are there described as "flattened, disc-like bodies, slightly papillate externally, and with a minute point of attachment at one side and sometimes with a slit more or less gaping at the other. Viewed under the microscope as transparent objects, they appear yellow, like amber, and show little structure except that the walls can be distinguished from the internal cavity, and the latter is seen in places to contain patches of granular or flocculent matter."

The shale in which these discs were found contained bituminous matter and burned with much flame. There were also other small particles which Prof. Dawson believed to be stems of a species of *Calamites*. The description of these stems may be accepted as applying to similar particles found adhering to or associated with the discs as noticed by us in 1865-67, and since. What these discs are seems to be yet a question. Prof. Dawson appears to have given no further attention to the subject till 1882, when Prof. Edward Orton, of Columbus, Ohio, reported the discovery of similar bodies in the Erian and lower Carboniferous shales of Ohio. Prof. Orton published his discovery in the transactions of the *American Association for the Advance-*

ment of Sciences for that year. At the same meeting of the association, in the discussion of Prof. Orton's paper, Prof. Williams, of Cornell University, mentioned that he had found similar bodies in the Hamilton shales of New York, and that they were associated with a curiously pinnated plant, a species of *Ptilophyton*.

Prof. J. M. Clarke, of Northampton, Mass., subsequently reported the presence of similar bodies in the Genesee shales, and also from the Carboniferous limestones. All these reports, however, did not enable Prof. Dawson to definitely assign to this form its proper place in the flora of this early age. In March, 1883, Mr. Orville Derby, of the geological survey of Brazil, sent Prof. Dawson specimens from the Erian formation of that country, and which contained forms similar to those which had previously been discovered in North America. It appears that the late Prof. Hart had previously reported specimens which were by him assigned to the Carboniferous age, but which Prof. Dawson was inclined to think must belong to the upper Devonian. Prof. Dawson has given provisionally to the South American varieties the name of *Sporangites Braziliensis*, and to the North American forms the name of *Sporangites Bilobatus*, or *Huronensis*, and associates them both with the Acrogenous plants of the Devonian formation.

Prof. Orton's paper, in the transaction of the American Association, discusses in more detail the conditions under which these forms are found in Ohio. They are distributed throughout the upper Devonian formations and through the immense thickness of these deposits, in some places not less than 1000 feet. They do not, however, present the same characteristics in every horizon of this formation. They vary in size and in other respects, which leads Prof. Orton to think there are grounds for separating them into several species. What these differences are except size he does not state. His description may in the main be taken for the discs found in our own clays.



We have, however, none so large as those discovered by Prof. Orton. Our largest forms are not more than $\frac{1}{8}$ of an inch in diameter, and our smallest about $\frac{1}{250}$ of an inch. We have two and possibly more varieties. One has a well-marked ledge or zone around it, and extending perhaps one-eighth of the way across it. Within this are the spines noted below. Others have no such markings, and do not as a rule have spines, and while some are in color a very light yellow or amber, and almost transparent, others are of a dark reddish brown and almost opaque. Whether these differences are sufficient to justify their separation into different species, seems to be at present doubtful. So far no forms have been met with by either of us having anything like a stem or point of attachment. Nor have we found any of the spherical or oval sacs which were contained in the collections of Mr. Derby.

There are found here, however, what we believe have not been found elsewhere—namely, on many of the discs, are well-marked *spines*. These spines, as a rule, occupy a central portion, the diameter of which is about three-fourths of the entire breadth of the disc, but in some instances they cover the entire surface. Along with these discs are, in quite large quantities, broken pieces of what seem to have been leaves; perhaps pinnate in form. In addition to these forms, dark globular masses, which seem to be, possibly, spores or microspores, are frequently seen on the discs, and also scattered among them, and are—at least, in some cases—also contained within the substance of the discs. They are regular in form, and vary in size from $\frac{1}{8000}$ to $\frac{1}{8000}$ of an inch in diameter. They are evidently organized, for in some cases there is seen a reticulum or net-work within the dark substance of the body. With these microspores, if such they are, are also masses of dark matter that, at least in some cases, are made up either of these globular forms alone, or of these and other organic material, such as the stems described by both Prof. Dawson and Prof. Orton. The clay beneath the city of Chicago and in the vicinity is full of boulders of various sizes, from that of a walnut, up to several cubic yards, and on many of these boulders are well-defined ice markings. Some of the smaller boulders are shale, which has never been ground down, and in these unchanged pieces we also find frequently large numbers of discs. These masses of shale, so far as we can ascertain, are identical with the shales of the upper Devonian formation, and, like the black shales of Ohio, burn with a clear, bright flame, giving out a strong petroleum odor.

It will be seen that the discs are evidently not the product of their present location. They have been in some far-off age imbedded in the shales, and subsequently these shale deposits have been broken up and most of it ground to clay, and with other material constituting the "Boulder Clays" have been redeposited beneath the lake and the adjacent shores. They are now undergoing another dispersion, for they are being washed from their present position in the Chicago clays and are mixed with the sands and alluvium to be carried by the currents and winds to some new resting place. Conse-

quently our water-supply is now full of these products of probably some millions of years ago. And with the aid of the Microscope, they now testify that in some remote period of time, and amid very different surroundings, an abundant marine vegetation was being produced which has been preserved to our own day. On the tables are Microscopes and slides which illustrate how abundantly they exist in the clays of our "boulder drift," in the Black Shales of Ohio, and in the water from our hydrants.

Prof. Orton has called attention to the great quantities of resinous matter contained in these shales. If a piece containing these discs is held in the flame of a spirit lamp, the discs burn like resin, and leave the pit or mold in the rock which they have occupied distinctly marked. In some localities, these shales have been distilled, and one ton of the black Ohio shales has been made to yield twenty gallons of oil. This has been done as a business, and we understand has been made to pay.

Prof. Orton suggests that these bodies are in part at least the origin of the petroleum found so abundantly in or near the horizon of the Devonian formations in Pennsylvania and other localities constituting the oil regions.

It seems not improbable that this hypothesis is correct. These plants must have been very abundant through a wide extent of territory and continuing through a long period of time. The study of their distribution is not yet complete, but the Committee beg to call attention to the fact that these organisms were, so far as known, first discovered here in the tunnel clays, and secondly they have never been found elsewhere except *in situ*.

NOTE BY B. W. THOMAS.

Since the reading of the report of your Committee on the "Microscopical Organisms found by them in the Boulder Clays underlying Chicago and vicinity," at the January meeting of the Academy, in the absence from the city of Dr. Johnson, I have individually continued the examination of drift material in this vicinity and from other parts of the Northwest.

So far as examined, all of the clays on the west shore of Lake Michigan, from Kenosha, Wis., on the north, to the Indiana State line on the south, contain an abundance of the *Macrospores* referred to in that paper, both free in the clay and *in situ* in fragments of shale. These clays range from some seventy feet above the level of Lake Michigan to (I am advised) over 200 feet below its surface.

In the examination of clays from other localities, I get some very unexpected results. In several specimens of "Blue Boulder Clay" kindly sent by Prof. N. H. Winchell, State Geologist of Minnesota, as "taken from fourteen to twenty-one feet below the surface when digging a well at Litchfield, Meeker County, Central Minnesota," I find an abundance and several species, of fossil *Rhizopods*, fragments of *Diatoms*, several species of well-

preserved and characteristic *Foraminifera*, among others *Textularia globosa*, *ul* *Rotalia globosa* and *Globigerina*, as identified by Prof. Joseph Leidy, who advises me that these forms are yet living and common in the Atlantic Ocean. A disc form with crenate margin, resembling the lorica of an infusorian, is quite abundant, and large quantities of forms and fragments not yet identified. From the great similarity of some of the contents of the Minnesota clays with what we find associated with the macrospores in the Chicago clays, I am quite confident that we shall yet find in the Minnesota clays, mingled with *Rhizopods*, etc., of the *Cretaceous* formation, the shale an macrospores of the *Devonian*.

All of the forms yet identified, both in the Chicago clays and in those from Minnesota, are undoubtedly of marine origin.

In a specimen of clay from the lower drift deposit, 135 feet below the surface, kindly sent to me from Bloomington, Ill., by Dr. G. W. Mason (there are two well-defined deposits in that vicinity, separated by a stratum of black soil and quantities of well preserved timber, with stumps of trees apparently in their natural position), I find discs similar in every way to the macrospores found here, except that they are smaller in size.

CHICAGO, February 9, 1884.